INSTRUCTION MANUAL
FOR THE
PEAK POWER CALIBRATOR
TYPES 8900A AND 8900B

MP MASTER
MA25132

BOONTON RADIO COMPANY

Green Pond Road Rockaway, New Jersey

U. S. A.

IM/CP/12-63 Printed in U.S.A.

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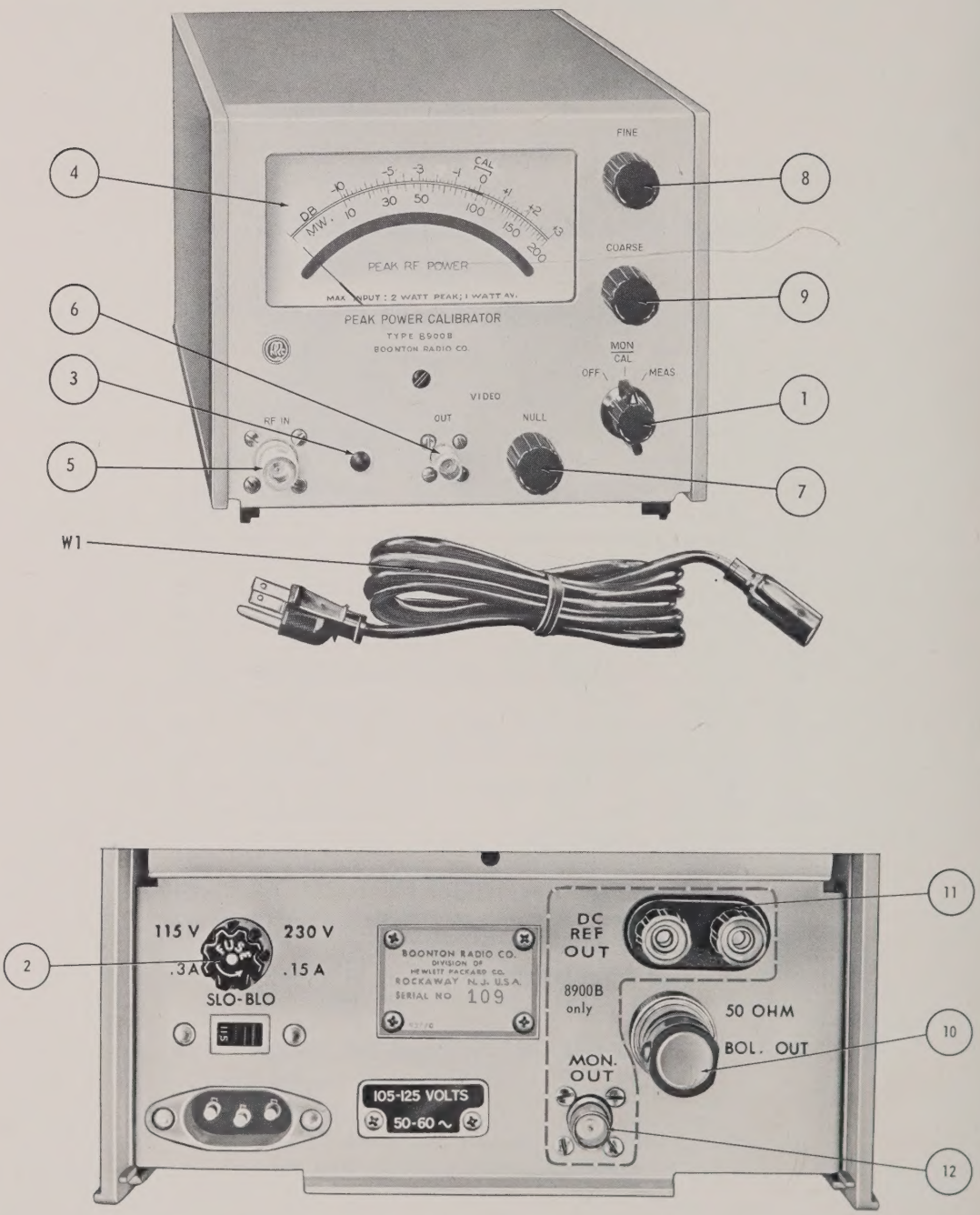


Figure 1. Operating Controls and Layout

SECTION I
DESCRIPTION

GENERAL

The Types 8900A/B Peak Power Calibrators provide a convenient means for measuring the peak RF power of pulses in the range of 50 to 2000 mc. The power level is read out directly on the panel meter and is independent of repetition rate and pulse width (>0.25μsec.). These instruments consist basically of a precision 50-ohm input circuit, diode peak detector, variable dc reference supply, meter, and a chopped video output system. The 8900B (only) also provides a wide band, low impedance, detector output for pulse monitoring and a dc output for monitoring the dc reference level at the meter.

In operation, the RF signal is applied to the input circuit, which, through a power divider, feeds the diode detector. The demodulated diode output and the output of the calibrated dc reference supply are alternately passed on to the video output jack through a mechanical chopper. In operation, the variable dc supply is standardized to the demodulated diode output on an oscilloscope. The meter then indicates the dc reference level which is calibrated in terms of peak RF power.

The Peak Power Calibrator is completely self-contained and housed in a modular cabinet which can be adapted, using a combining case, for standard rack mounting.

TYPE 8900B

All of the information concerning the Peak Power Calibrator refers to both the 8900A and the 8900B except where noted.

1. An emitter follower consisting of two transistors with associated circuitry is incorporated in the 8900B. The input to the emitter-follower is the demodulated diode output. The emitter follower output connects to the MON. OUT connector on the rear panel of the instrument.

2. The dc reference voltage is available at the rear panel at a set of terminals (DC REF OUT) on the 8900B.

3. The 8900B utilizes a plug-in circuit board in contrast to the conventional wiring in the 8900A.

OPERATING CONTROLS AND LAYOUT

A front and rear view of the instrument with all of the controls is shown in Fig. 1. All of the controls for operation of the 8900A/B are located on the front panel of the instrument. Instrument front panel designations are shown below within quotation marks. Rear panel designations are in parenthesis.

1. Function Switch "OFF-CAL-MEAS" on 8900A, "OFF-MON/CAL-MEAS" on 8900B

This switch turns on the instrument in the CAL and MEAS positions. It also provides the proper circuit connections for calibrating the instrument and using the instrument for measuring purposes. For pulse waveform monitoring at the 8900B MON.OUT connector, the Function Switch must be in the MON/CAL position.

> **NOTE:** The MON/CAL position will be referred to in this manual by the function being performed. When the function is monitoring, it will be called MON and when it is calibration it will be called CAL.

2. Fuse

This fuse in the ac line is located on the rear panel of the instrument (.3 amp for 105-125 volt input, .15 amp for 210-250 volt input).

3. Pilot Light

4. Peak RF Power Meter "PEAK RF POWER"

The peak RF Power Meter monitors the variable dc reference voltage level and is calibrated to read peak RF power. The meter is calibrated in milliwatts, 0 to 200 and in db from —10 to +3, with 0 db equal to 100 mw.

5. RF Input Connector "RF IN"

The RF signal to be measured is connected to this Type N connector. Maximum power which may be connected directly to this input is 2 watts peak (1 watt average). The input power measuring range may be readily increased by use of suitable external attenuators or directional couplers.

6. Video Out Connector "VIDEO-OUT"

This BNC connector is used to supply the chopper output to a suitable oscilloscope for comparison of the detected RF pulse and the dc reference. The oscilloscope requirements for this application are:

a. Bandwidth sufficient to display the pulse waveform to be measured.

b. Vertical amplifier dc coupled.

c. Sensitivity of at least 50 mv/cm.

7. Video Null Control "VIDEO-NULL"

With the Function Switch in the CAL position and no RF signal applied, the VIDEO NULL control is used to balance out the diode operating bias from the video waveform.

8. Fine Control "FINE"

9. Coarse Control "COARSE"

These controls provide a means for adjusting the dc reference voltage, as monitored by the Peak RF Power Meter, to the peak of the detected RF pulse, while observing the waveform on an oscilloscope.

10. Bolometer Output Connector (BOL. OUT)

This Type N connector normally has the externally mounted 50-ohm termination connected to it. During the calibration procedure, this termination is replaced by an average power indicating instrument such as an -hp-431B.

11. DC Reference Output (DC REF OUT—8900B only)

These two terminals are connected to the variable reference voltage within the instrument to provide access to the dc reference voltage as it is applied to the Peak RF Power Meter.

12. Monitor Output (MON. OUT.—8900B only)

This BNC connector allows the output of the internal diode detector to be observed on an oscilloscope without passing through the chopper. This is a low impedance (150-ohm) output which may be used for general waveform monitoring or oscilloscope external synchronization. (See Section V—Operational Guide.)

SECTION II
SPECIFICATIONS

Radio Frequency Measurement Characteristics

RF RANGE: 150 to 1500 MC (8900A)
50 to 2000 MC (8900B)

RF POWER RANGE: 200 mw* peak full scale
*may be readily increased through use of external attenuators or directional couplers

RF POWER ACCURACY: ± 1.5 db*
*± 0.6 db with custom calibration curve

RF POWER PRECISION: 0.1 db

RF PULSE WIDTH: > 0.25 μsec

RF REPETITION RATE: 1.5 MC maximum

RF IMPEDANCE: 50 ohms

RF VSWR: < 1.25

Monitor Output (8900B only)

LEVEL: > 0.2 volt for 20 mw input

IMPEDANCE: 150 ohm nominal

BANDWIDTH: 1 KC to 7 MC

Physical Characteristics

MOUNTING:
Cabinet for bench use; adaptable for 19″ rack mounting

FINISH:
Gray engraved panel; green cabinet (Other finishes available on special order)

DIMENSIONS: (See Fig. 2)

WEIGHT: Net: 10 lbs. (4.5 kg)

Power Requirements

8900A/B: 105-125/210-250 volts, 50-60 cps

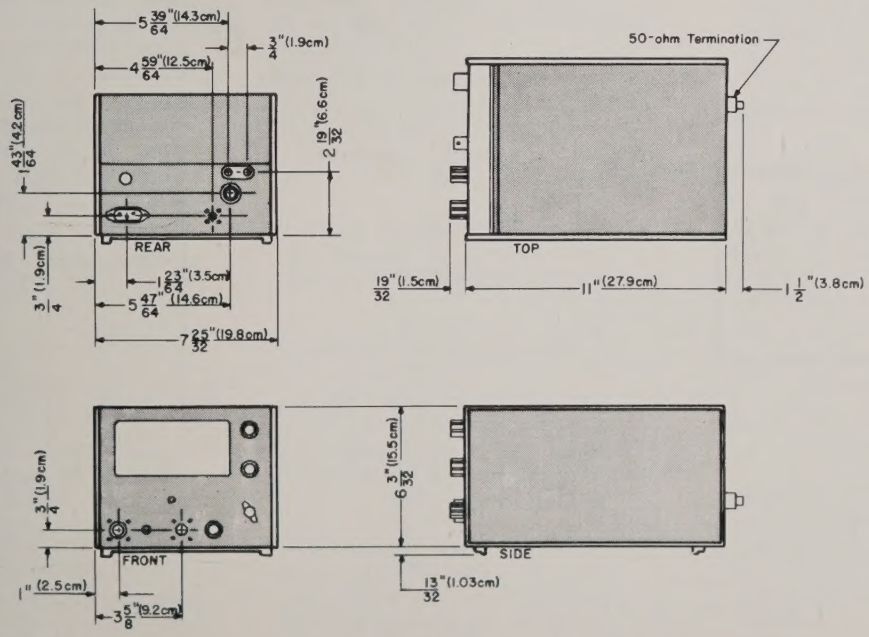


Figure 2. 8900A/B Dimensions

SECTION III
OPERATING INSTRUCTIONS

INSTALLATION

Remove the 8900A/B from its shipping carton and place it in position on a test bench.

This instrument may be rack mounted after installing the 8900A/B in a combining case (-hp-1052A). The 8900A/B fills one-half of a rack mounting combining case. See Fig. 3. The unused space in the case may be covered by a blank panel (available as an accessory to the combining case).

Connect the power cord to the power socket on the rear panel of the 8900A/B. Then connect the power cord to a 105-125 volt, 50 or 60 cycle source. An input voltage switch, mounted above the power socket, may be operated to permit use of a 105-125 or 210-250 volt, 50 or 60 cycle source.

NOTE: The voltage plate on the rear panel should agree with the switch position. Use appropriate fuse as indicated in Section 1 "2. Fuse."

This instrument requires negligible warmup time.

CAUTION: DO NOT exceed power input limit at front panel "RF IN" connector as specified on the meter (2 WATTS PEAK OR 1 WATT (AVERAGE) or damage WILL result.

OPERATING PROCEDURE

1. Connect an oscilloscope to the VIDEO OUT connector.

NOTE: The oscilloscope bandwidth required is dependent on the waveshape being measured. The vertical amplifier must be dc coupled. For optimum resolution use the highest practical vertical sensitivity on all oscilloscope displays.

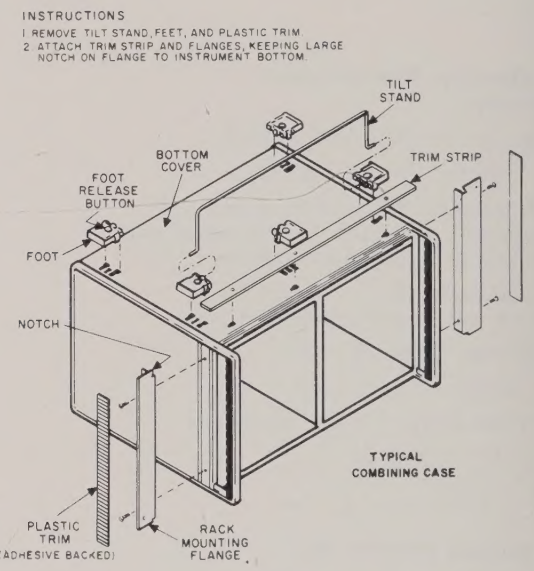


Figure 3. Rack Mounting Instructions

2. Check to see that the 50-ohm termination is properly connected at the BOL. OUT connector on the rear panel.

3. Connect the source of RF pulse power to be measured to the RF IN connector on the front panel throuh a suitable attenuator or coupler, if required.

NOTE: 1. Attenuators or couplers should be selected to provide attenuation as shown in Table I.

2. The attenuator calibration accuracy is directly additive to the basic power measuring accuracy of the 8900A/B. For a worst case analysis, therefore, precision pads of known accuracy should be used.

3. Set the Function Switch to the CAL position. The pilot light should light (indicating power to the instrument) and the front panel meter pointer should indicate within the CAL marking on the meter scale. This operation confirms that the dc reference supply and meter movement are working satisfactorily. The 8900A meter has a single calibration mark on the meter scale and the meter pointer should indicate within +.2 and −.4 db of this mark.

Attenuation	*F.S. Watts*	*F.S. dbm*
0 db	200 (mw)	+23
10 db	2	+33
20 db	20	+43
30 db	200	+53
40 db	2000	+63

Table I. Attenuation Requirements

4. With the source of RF power to the 8900A/B turned OFF, and the oscilloscope set to "free run", adjust the VIDEO NULL control until the two horizontal lines, observed on the oscilloscope, are

superimposed (See Fig. 4). This operation balances out the detector diode bias from the video waveform which might otherwise be read as RF power.

5. Turn ON the source of RF power to the 8900A/B.

6. Set the Function Switch to the MEAS position.

7. With the oscilloscope dc coupled, synchronize the sweep, if possible, from the pulse source or the 8900B MONITOR OUTPUT, with the sweep time set to provide optimum visual observation. If necessary, use the internal synchronization of the oscilloscope.

8. Using the COARSE and FINE controls, adjust the dc reference voltage until the adjustable horizontal line coincides with the peak of the pulse as displayed on the oscilloscope (See Fig. 5).

NOTE: For optimum resolution, use the highest practical oscilloscope vertical sensitivity. Keep the trace in view with the vertical position control.

9. Read the peak power on the front panel meter. If external attenuation is used, determine actual peak power using Table I.

NOTE: The reading observed on the meter is accurate within ±1.5 db. This reading may be applied to the Custom Calibration Chart (Fig. 6), furnished as an accessory with the 8900A/B, for a peak power accuracy of ±0.6 db. These accuracies are based on absolute worst case errors.

The NULL control need not be adjusted for repetitive measurements.

CALIBRATION CHECK

The following procedure is used to check the calibration of the 8900-A/B at one frequency and one power level. This check will verify the accuracy of the instrument and can be readily performed if instrument damage is suspected.

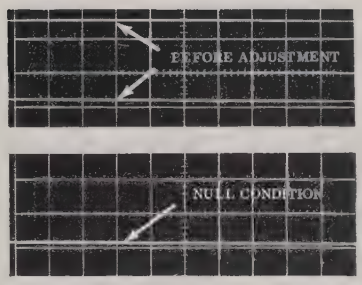


Figure 4. Oscilloscope Display — Null Adjustment

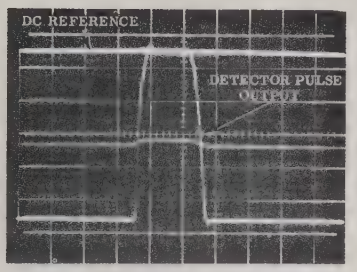


Figure 5. Oscilloscope Display — Pulse Measurement

Equipment Required

The following equipment is sufficient for a calibration check. See the Recommended Equipment List — Section VI — Maintenance for added specifications.

1. CW RF Generator covering desired frequency or frequency range.

2. CW Power Standard with 2% accuracy such as the -hp- 431B Power Meter with the -hp- 478A Thermistor Mount (CALIBRATED TO 2%).

3. -hp- 130C Oscilloscope or equivalent.

4. Low VSWR Attenuators: 10 db and 3 db.

5. Low Pass Filter.

The second harmonic power component must be suppressed at least 27 db (or 54 db in terms of voltage) below the fundamental frequency being measured.

6. Low VSWR, Double Female, Type "N" Connector.

Preliminary Setup

1. Connect the equipment as shown in Fig. 7.

2. Set the 8900A/B Function Switch to the MEAS position.

3. Adjust the RF Generator frequency to 900 mc (or other desired frequency).

4. Adjust the RF Generator output until the CW Power Standard reads 12 dbm.

Path Attenuation Check

1. Remove the equipment connectors from the 8900A/B RF IN and 8900A/B BOL. OUT connectors and insert the Double Female, "N" connector in place of the 8900A/B without touching any of the controls

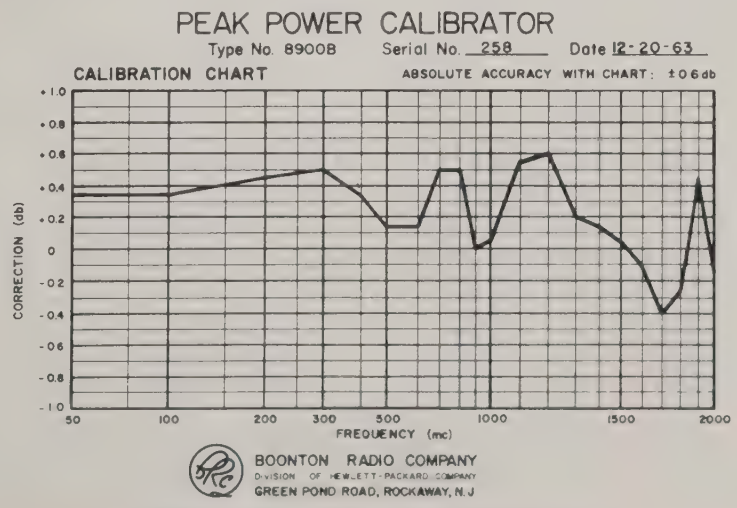


Figure 6. Typical Custom Calibration Chart

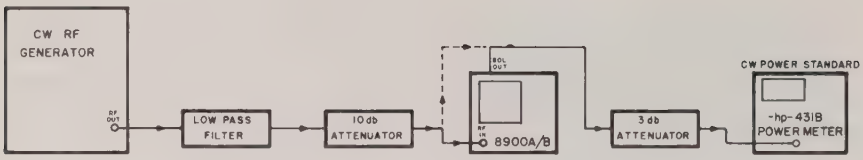


Figure 7. Path Attenuation Check Set-up

on the generator. The CW Power Standard reading will increase by approximately 16 db to nominally 4 dbm. Note and record the exact change in power, which is the path attenuation of the 8900A/B at 900 mc.

2. Reconnect the 8900A/B and remove the 10 db attenuator, replacing it with the 3 db attenuator (Fig. 8). Connect the CW Power Standard and the oscilloscope as indicated in the diagram (Fig. 8).

Null Adjustment

1. Without changing the RF Generator frequency, turn the RF output off.

2. Rotate the 8900A/B Function Switch to the CAL position. The pointer on the RF Peak Power meter should fall within the calibration marking on the meter scale. The 8900A has only a single calibration mark. The pointer should fall within +.2 and −.4 db of this mark.

3. Set the oscilloscope verticle amplifier to direct coupling with the sweem set to "free run".

4. Adjust the 8900A/B NULL control until the two horizontal lines on the oscilloscope coincide. Use the highest oscilloscope vertical sensitivity practical for the most precise adjustment.

5. Rotate the 8900A/B Function Switch to the MEAS position.

6. Turn on the RF Generator output and adjust the output level until the CW Power Standard reads 100 mw (100 mw is 20 dbm) minus the path attenuation determined in Step 1—Path Attenuation Check.

EXAMPLE: If the path attenuation for the particular instrument checked measured 16.2 db at 900 mc for 100 mw at the 8900A/B RF IN connector, the CW Power Standard should indicate 20 dbm −16.2 db or +3.8 dbm. Adjust the output of the RF Generator for a reading of +3.8 dbm, as indicated on the CW Power Standard. This will make the power at the 8900A/B RF IN connector exactly 100 mw.

7. Adjust the COARSE and FINE controls on the 8900A/B until the two horizontal lines on the oscilloscope exactly coincide. The RF Peak Power meter on the 8900A/B should read 100 mw (0 db) ±1.5 db, which is the specified accuracy of an uncorrected measurement.

NOTE: If the Custom Calibration Chart (Fig. 6) is supplied with the instrument, the corrected meter indication should be within ±0.6 db of 100 mw, the specified accuracy with the Custom Calibration Chart.

Readings outside of these limits indicate defective operation, need for recalibration of the instrument, or an invalid measurement. It should be emphasized that reasonable care must be exercised in the performance of a calibration check since defective cables, connectors, or test equipment can produce invalid results.

For a complete calibration and adjustment procedure, see Section VI—Maintenance.

DC REFERENCE OUT (8900B ONLY)

The DC REF OUT connector is provided to permit use of a chopping system operating at other than line frequency, if desired. For this operation it is necessary to deactivate the internal chopper and make a connection between the detector diode output and the VIDEO OUT connector. This is accomplished by removing the chopper (G1) and installing an octal plug with a jumper from PIN 7 to PIN 8. The external chopper can be connected with one arm to the VIDEO OUT connector, one arm to the DC REF OUT connector, and the selecting arm to an oscilloscope. If a dual trace oscilloscope is used, the external chopper may be eliminated by connecting the 8900B outputs to the two vertical inputs of the oscilloscope with the vertical amplifiers set to the same sensitivity.

Another application of the DC REF OUT connector is the measurement of "one-shot" or non repetitive waveforms. Plotting a curve of Peak RF Power Meter readings vs. DC REF OUT voltage produces a calibration of DC output in terms of Peak RF Power.

With this information, Peak RF Power of non-repetitive, or even repetitive, waveforms can be determined from visual records made with an oscilloscope camera or X-Y plotter.

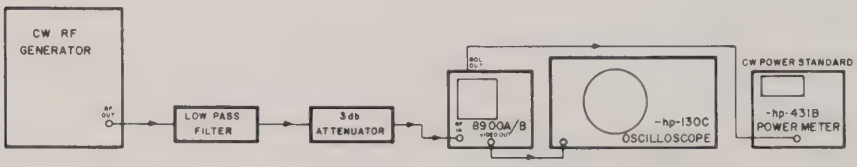


Figure 8. Meter Calibration Check Set-up

SECTION IV
THEORY OF OPERATION

DEFINITION OF PEAK POWER

The 8900A/B Peak Power Calibrator measures peak power as contrasted to average power measured by conventional bolometers and calorimeters. The relationship between peak and average power may be defined as follows:

$$P_{ave} = P_{peak} \times \text{Duty Cycle.}$$

Duty cycle is the fractional time a pulsed source is turned on. If the source were turned on 100% of the time, the duty cycle would be 1 and peak power and average power would be equal. Peak power, then, could be explained as the average power that would exist if the pulsed source were left on all the time. It is not the instantaneous peak power or envelope peak power that exists at the peak of the RF voltage waveform. Assuming a sinusoidal CW source with an average power of 1 watt, the peak power rating of the source is 1 watt also. If the source is turned off 50% of the time, the average power will be ½ watt, whereas the peak power rating remains 1 watt.

METHOD OF MEASUREMENT

For a sinusoidal CW source it is generally agreed that:

$$P_{ave} = \frac{E_{rms}^2}{R_o} = \frac{(.707E_{peak})^2}{R_o} = \frac{(E_{peak})^2}{2R_o}$$

The average power and peak power of a source are equal if the duty cycle is 1. The voltage waveforms, then, must be identical for the duration of time the source is turned on, assuming a system of constant characteristic impedance or R_o. The peak voltage of the CW mode will be the same as the peak voltage when the source is pulsed, even though this is not the parameter to be measured. It is, however, a means of correlation between the two. Employing a device known as the peak detector, we have an element which will respond identically, for a duration of time, to both a CW and a pulsed source of the same power rating. While elements, such as a bolometer, may respond quite differently to the two, depending on the heating effect, the peak detector does not. This is the principle of the 8900A/B Peak Power Calibrator.

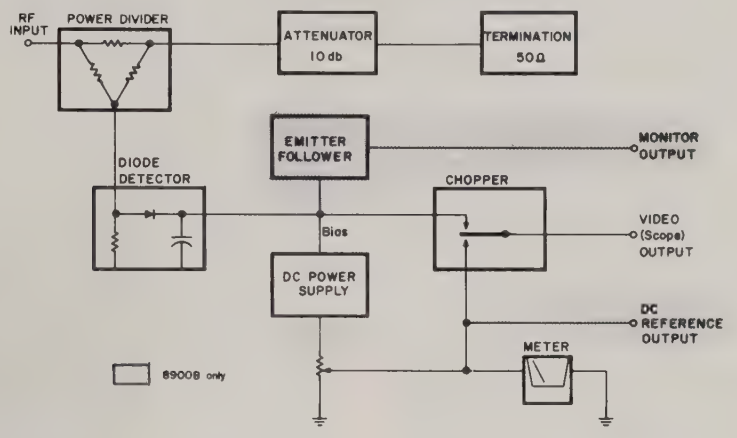


Figure 9. Block Diagram — 8900A/B

DESCRIPTION OF OPERATION

Figure 9 is a block diagram illustrating the basic operation of the 8900A/B. It can be seen that a signal applied to the front panel input connector is sent through two paths by virtue of the power divider. In one path, the signal passes through a 10 db attenuator and is absorbed in a 50-ohm termination. In the other path, the signal arrives at a diode peak detector which develops a dc level equal to the peak voltage of the RF waveform applied to it. The diode is forward biased to bring it to an operating point of maximum stability and to bring it away from the square-law region to produce a somewhat more linear change in output voltage for a change in the applied RF level. As the diagram indicates, a variable dc supply is included also. The output of the supply is connected to a dc meter, which monitors its voltage, and to one leg of a mechanical chopper. If the chopper is set in operation and its selecting arm is connected to an oscilloscope, one can look first at the dc level produced by the peak detector in response to an RF voltage, and then at the dc level from the variable dc reference supply. In performing a measurement, the variable supply is adjusted until the two voltages are exactly equal. The dc meter monitoring the output of the variable supply is calibrated in terms of RF level required to produce a given dc from the peak detector, and hence, peak RF power can be read from it directly. CW power, of course, is correctly indicated also, since the calibration is in terms of the peak voltage waveform.

The design of the peak detector

is an important factor in the reduction of errors. The output capacitor must be charged to the true peak of the waveform within the duration of the pulse, though not necessarily on the first cycle of the RF carrier. It may charge up in staircase fashion over a period of several cycles, but must reach the peak before a measurement is made. The 8900A/B specification states that 0.25 μsec. should be allowed for this, although 0.10 μsec. is typical with a 6-foot length of RG-62/U (90 ohm) cable and an oscilloscope with 50 pf input capacitance connected to the video output. Since no isolating amplifier is employed, extremely high external capacitance could increase the time required for the video output to rise to the true peak of the voltage waveform. The impedance of the output circuit is approximately 350 ohms. The peak detector also has a responsibility to remain faithful at low RF carrier frequencies. It must not start to discharge while it is waiting for the crest of the next cycle of the RF voltage waveform to appear. If it falls by even a few per cent, the dc output level, within the duration of the pulse, would be lower than the true RF voltage peak and an error would be introduced. The 8900A/B was designed to meet its accuracy specification at carrier frequencies down to 50 mc. The upper frequency limit is 2000 mc. A front panel "NULL" control is included to permit the user to "erase" the static dc bias on the diode from the video presentation. While this control need not be reset for a repetitive series of measurements, it gives the operator a range of adjustment to compensate for any possible long-term aging effects on the diode. This adjustment is made with the Function Switch in the "CAL" position.

In this position, also, a voltage divider from the reference power supply applies a preset voltage to the dc meter to deflect the needle to a calibration mark. It should be noted, however, that unlike some measuring systems, the reference supply is not really a critical parameter in the measurement because it is being used only for comparison rather than as an absolute reference for the measurement. The meter calibration is the absolute reference.

Now consider the signal path which attenuates the incident power and dissipates the remainder in a 50-ohm load. This is provided as a convenient means of calibrating or standardizing the instrument. If the 50-ohm load is replaced by an accurate CW power measuring device, such as a bolometer or calorimeter, and a CW source is connected to the input connector, the effect of the applied power level can be monitored on the average reading CW standard and the peak reading diode detector simultaneously. Therefore, one need only to know accurately the attenuation between the front panel input connector and the CW standard to determine what effect a known power level at the input has upon the peak RF detector. The 10 db pad is introduced to reduce the CW level to one within the range of several commercially available standards. The CW source requirements are also met by readily available units.

EMITTER FOLLOWER

The 8900B (only) includes a two-stage emitter follower to provide an isolated monitor output for viewing and analyzing the demodulated output on an externally connected oscilloscope.

The output bandwidth is 1 kc to 7 mc permitting useful reproduction of a variety of waveforms. This output may also be used for synchronizing the oscilloscope sweep circuitry during a peak power measurement.

SECTION V
OPERATIONAL GUIDE

INTRODUCTION

The Operational Guide is a section devoted to practical application of the 8900A/B Peak Power Calibrator. This added information should assist in providing more accurate results as the capabilities and limitations of the instrument are expanded upon.

CUSTOM CALIBRATION CHART

The Custom Calibration Chart (Fig. 6) supplies correction for errors attributable to the frequency sensitive components in the RF circuitry of the instrument. This chart information is obtained by maintaining a constant 100 mw (0 db) input to the Peak Power Calibrator and plotting the required meter correction over the frequency range as measurements are made. See Calibration Procedure in Section VI—Maintenance for more detailed information.

The worst case errors due to frequency sensitivity add up to ±0.7 db and are contributed by the following elements:

1. The power divider.
2. The 10 db attenuator.
3. The diode detector.
4. Associated connectors.

ACCURACY

A basic objective of the 8900A/B is to provide a peak power measuring instrument of sufficient accuracy to serve as a working standard without the usual rigorous limitations of standards laboratory equipment. The high quality, forward biased diode is an order of magnitude more stable, environmentally, than an uncompensated bolometer or calorimeter. Operator skill level, also, has been reduced to an absolute minimum.

While the specified accuracy of the Peak Power Calibrator is ±0.6 db when using the Custom Calibration Chart, utilization to a higher degree of accuracy, by virtue of its inherent stability, is both practical and recommended. The ±0.6 db figure is based on absolute worst case error. It is also based on a minimum of standards equipment to perform a calibration. With high quality standards laboratory type equipment for calibration, operation to about ±0.3 db worst case error is considered practical.

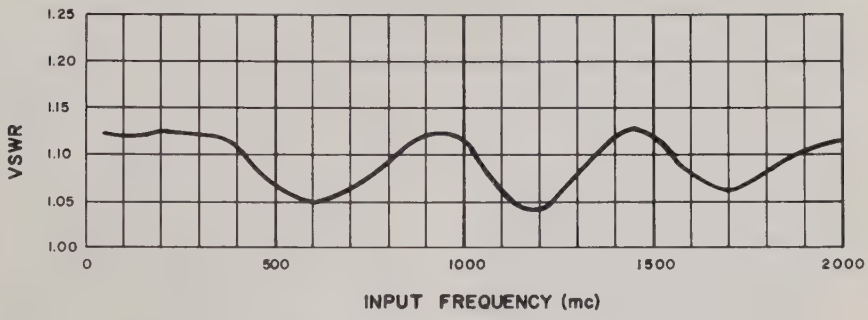


Figure 10. Typical Input VSWR

The worst case errors are contributed by the following:

1. Measurement of the 16 db (nominal) path attenuation from the RF IN connector to the CW standard output (BOL. OUT) connector.
2. CW Standard.
3. Input VSWR reflection error. The typical input VSWR over the 8900A/B frequency range is shown in Fig. 10.
4. Meter tracking and repeatability error.
5. Operator readout.
6. Possible aging of the detector diode.

Reviewing the factors that can cause errors in the measurement, it can be seen that some items are more difficult to correct than others. However, by use of accurate standards laboratory quality instruments and observing the following suggestions, very accurate measurements can be made:

1. Calibrate the 16 db (nominal) attenuation path to an accuracy of ±0.1 db or better.
2. Use a 1% or better CW power standard.
3. Calibrate the instrument at the power level to be measured to eliminate meter tracking errors.
4. Tune the input circuit to a VSWR of 1.00 to 1.

The above steps should permit operation to a ±0.3 db worst case error in the basic range of the instrument.

IMPORTANCE OF THE OSCILLOSCOPE

A basic factor in the philosophy of the 8900A/B is that of actual observation of the pulse waveform during the measurement. While this requires the use of a suitable auxiliary oscilloscope, it is considered important in the reduction of subtle errors; some of which are variations in pulse width, rate, or shape. It has an inherent advantage, in permitting measurement of intermediate levels of power in a complex waveshape. The operator may ignore characteristics, such as overshoot, if they contribute nothing to the effective-

ness of his system, or he may measure them as he chooses. In some applications, the user may be monitoring the effectiveness of a system at the time the measurement is made in an effort to correlate system performance to peak RF power. It then becomes important that he verify that the output power has not changed by even a few tenths of a db at the time of the reading. A typical oscilloscope display from the 8900A/B during a measurement is shown in Figure 11.

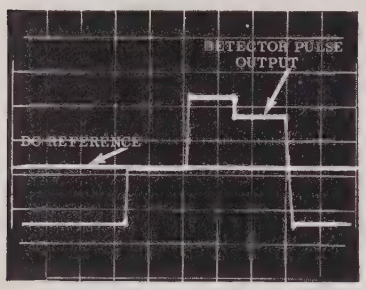


Figure 11.
Typical Oscilloscope Display

EMITTER FOLLOWER (8900B)

A two-stage emitter follower isolating circuit connects the detector diode output to the rear panel Monitor Output connector (MON. OUT) with an impedance of 150 ohms. This makes the detector output available for waveform monitoring or other purposes such as external oscilloscope synchronization. The bandwidth of 1 kc to 7 mc in the amplifier produces useful reproductions for a variety of pulse shapes. A typical frequency response of this circuit from the RF IN connector to the MON. OUT connector is shown in Figure 12. In the MEAS position, the MON. OUT signal exhibits a square-wave change in amplitude which is caused by the chopper alternately applying and disconnecting a load to the detector diode and the emitter follower input. This load is caused by the capacitance of any cable attached to the VIDEO OUT connector. As the modulating signal frequency increases, the shunting effect of the capacitance increases, changing the video frequency response of the detector

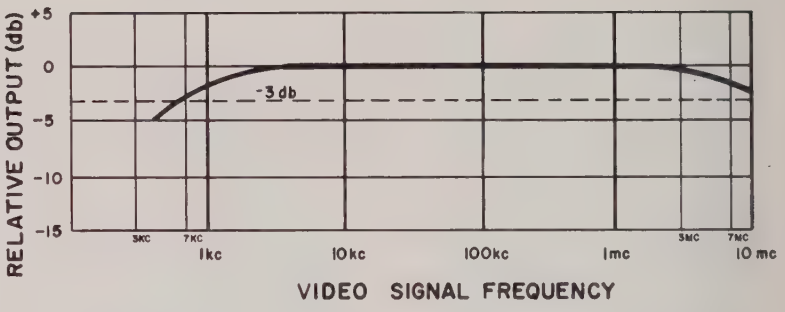


Figure 12. Typical Modulating Signal Frequency Response

diode. Therefore, the Function Switch should be in the MON position for waveform observation. In this position, a 10K resistor isolates the detector diode from the loading effect of the cable capacitance at the VIDEO OUT connector. The MON. OUT connector may still be used for external synchronization of an oscilloscope, with the Function Switch in the MEAS position, for most pulse waveforms.

SECTION VI
MAINTENANCE

GENERAL

The 8900A and 8900B Peak Power Calibrators are easy instruments to maintain. All parts are accessible after removal of the top, bottom, and side covers. The 8900B is especially easy to work on with its plug-in circuit board containing most of the circuitry in the instrument.

TROUBLE SHOOTING AND REPAIR

Voltage and Resistance Chart (See Page 26)

The Voltage and Resistance Chart indicates normal operating conditions for the 8900B Peak Power Calibrator with no external equipment attached. Unless otherwise indicated, the comparable points shown in the chart are for the 8900A also. Voltages were checked with a VTVM (-hp- 410B). Resistance readings were made under the same conditions with the power disconnected. Some resistance readings were omitted as they have no significance; i.e., cases where electrolytic capacitors or semiconductor devices are connected in the circuit.

MECHANICAL DISASSEMBLY PROCEDURE

Top and Bottom Covers

1. Remove two screws at rear of instrument.
2. Slide cover toward rear of instrument to disengage lip at front panel.

Right and Left Side Covers

Remove screws from side covers. Top or bottom covers need not be removed to remove side covers.

Meter

1. Remove top, bottom, right and left side covers.
2. Remove all front panel knobs.
3. Remove screws securing the RF IN and VIDEO OUT connectors.
4. Remove all screws securing the side frames at the front of the instrument.
5. Loosen all screws securing the side frames at the rear of the instrument.
6. Spring side frames apart to allow front panel to drop forward.

> **NOTE:** The pilot light wires will restrict movement.

7. Remove wires from meter terminals.
8. Remove four nuts securing meter to sub-panel and slide meter out of instrument.

RF Detector Diode

1. Without removing the detector block from the instrument, loosen the socket head setscrew securing the diode with a No. 2 (.035″) hex wrench.

> **NOTE:** On the 8900B, the printed circuit board must be removed to gain access to the diode setscrew.

2. Lift out the diode.
3. Remove the bowed washer from the bottom pin of the diode.

When replacing the diode, the cap must be on the cathode end of the diode. The bowed washer from the original diode should be placed (concave side down) on the anode end of the diode. It is important that the diode be pressed firmly in place before tightening the socket head setscrew.

> **NOTE:** VSWR and custom calibration data must be taken after replacing the diode.

ADJUSTMENT AND CALIBRATION

Any tolerances listed in this section are the limits indicated by the Specifications in Section II. Factory adjustments are made to considerably closer tolerances. Field adjustments to closer than specified tolerances are possible if time and patience are used.

Recommended Equipment List

The following instruments are recommended for use in the adjustment and calibration of the 8900-A/B Peak Power Calibrator. Pertient information is given for substitution purposes.

1. -hp- 431B Power Meter (CW Power Standard)
Power Measurement Range: 1μw to 10 mw (full range not required)
Accuracy: ±3% of full scale

> **NOTE:** Instrument must be calibrated to ±2%.

2. -hp- 478A Thermistor Mount for use with -hp- 431B Power Meter
3. -hp- 130C Oscilloscope
Sensitivity: 0.2 mv/cm
Frequency Range: 0 to 500 kc
4. -hp- 412A dc VTVM
Range: 1 mv to 1000 v (full range not required)
Accuracy: 1% of full scale
5. High Output CW RF Generator or Generators to cover the range from 50 mc to 2000 mc with a minimum of 25 dbm (≈280 mw)
6. -hp- 212A Pulse Generator
7. -hp- 175A Oscilloscope
Frequency Range: 0 to 50 mc
8. Variable Metered Power Source
Output Range: 105-125 vac, 50-60 cps
9. Low Pass Filter or Filters
The second harmonic power component must be suppressed at least 27 db (or 54 db in terms of voltage) below the fundamental frequency at the filter output.
10. Low VSWR Attenuators: 10 db and 3 db
11. Low VSWR, Double Female, Type "N" Connector
12. 150-ohm Load
Can be assembled using a UG-88/U BNC connector and a 150Ω, 1 watt, ±10% carbon composition resistor.

Power Supply

EQUIPMENT REQUIRED

1. -hp- 412A dc VTVM or Equivalent*

**See Recommended Equipment List under Adjustment and Calibration*

2. -hp- 130C Oscilloscope or Equivalent*

3. Variable Metered Power Source*

PRELIMINARY SETUP

Connect the 8900A/B to the power source set to 115 vac. Connect the dc VTVM between TP1 (+) and TP2 (−). Set the Function Switch to the MEAS position.

MEASUREMENT AND ADJUSTMENT

1. Voltage should be nominally 9.2 vdc.

2. Change dc VTVM connections to a position between TP3 and ground. Voltage should be nominally −11.5 vdc.

3. Change dc VTVM connections to a position between junction of R5 - R25 and ground. Voltage should be approximately 0.37 ±0.8 vdc. Voltages out of this range usually are caused by a defective detector diode.

4. Change dc VTVM connections to position between TP2 and ground. Rotate the NULL control (R10) to minimum (full CCW).

5. Rotate R20 to full CCW position. Rotate the NULL control (R10) through its full range. Voltage should vary from 0 to −0.35 vdc minimum.

6. Change dc VTVM connections to a position between junction of R1-R7-C1 (+) and junction of R2-R8-R3-C2 (−). Voltage should be nominally 240 vdc.

7. Connect an oscilloscope between TP1 and ground. Set input voltage to 125 vac. If the ripple, as measured on the oscilloscope, exceeds 20 mv p-p, replace CR6.

8. Change oscilloscope connections to a position between TP3 and ground. If the ripple, as measured on the oscilloscope, exceeds 20 mv p-p, replace CR7.

NOTE: If either CR6 or CR7 is replaced, repeat steps 1 through 6.

9. (Type 8900B only) Connect the dc VTVM to the DC REF OUT terminals on the rear panel. With the FINE control full CCW, rotate the COARSE control over the full range. The dc VTVM reading should vary from 0 to 1.8 vdc minimum.

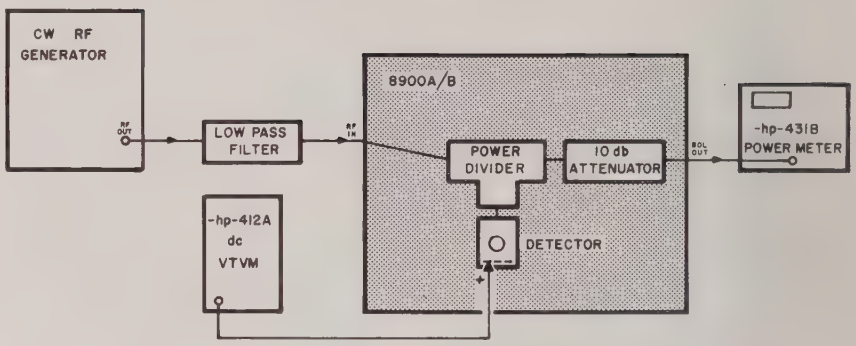


Figure 13. Detector Diode Check Set-up

Detector Diode Check

The 8900A/B maximum rated input is 2 watts peak or 1 watt average. The instrument can be used for measuring components in excess of these values, however, by use of suitable precision attenuators (See Section III — Operating Instructions). The detector diode circuit is designed with a minimum overload safety factor of 10, so in normal operation, the diode can not be easily damaged. Instrument damage can result, however, if a high power source is inadvertently connected to the instrument. The following procedure will determine the condition of the detector diode.

EQUIPMENT REQUIRED

1. CW RF Generator*

2. -hp- 431B Power Meter with -hp- 478A Thermistor Mount or equivalent*

3. -hp- 412A dc VTVM or equivalent*

PRELIMINARY SETUP

1. Connect equipment as shown in Fig. 13.

2. Remove chopper (G1) from its socket.

3. With the 8900A/B Function Switch in the OFF position, tune the RF generator to 1000 mc and adjust the output of the generator for 100 mw at the 8900A/B RF IN connector. 100 mw at the RF IN connector is read as +4 dbm on the power meter.

CHECK

The output voltage of a properly functioning diode is nominally 1 vdc. A diode not measuring between 0.80 and 1.20 vdc should be replaced.

Chopper

EQUIPMENT REQUIRED

1. -hp- 130C Oscilloscope or equivalent*

PRELIMINARY SETUP

Connect the oscilloscope to the VIDEO OUT connector on the Peak Power Calibrator. Synchronize the oscilloscope pattern at the chopper frequency (50 or 60 cps) and adjust the COARSE control until a square wave (the chopper operating response) appears on the oscilloscope.

PERFORMANCE CHECK

Fig. 14 shows a typical oscilloscope pattern of the chopper operation. Duty cycle is approximately 50%. Contact bounce will generally increase with use. The chopper assembly (G-1) can be readily replaced if contact bounce becomes excessive and impairs observations on the oscilloscope.

Input VSWR

Measure the input VSWR at the RF IN connector at 500, 1000, 1500, and 2000 mc. The input VSWR must be less than 1.25 to 1.

**See Recommended Equipment List under Adjustment and Calibration*

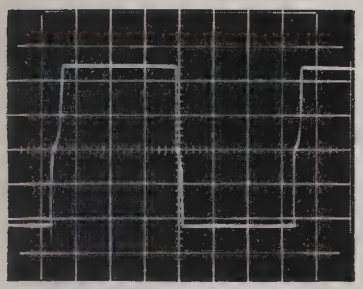


Figure 14. Chopper Performance

8900A/B Rise Time (VIDEO OUT)

EQUIPMENT REQUIRED

1. -hp- 212A Pulse Generator or equivalent*
2. -hp- 175A Oscilloscope or equivalent*
3. 50-ohm Load

PRELIMINARY SETUP

1. Connect the pulse generator to the oscilloscope using a 50-ohm load across the pulse generator output.
2. Adjust the pulse generator output for a 1 volt pulse as observed on the oscilloscope and measure the rise time of the pulse from the generator.
3. Disconnect the oscilloscope from the pulse generator and connect it to the VIDEO OUT connector (recommended oscilloscope lead—RG-62/U—90-ohm cable; no more than 6 feet long). Connect the pulse generator directly to the 8900A/B RF IN connector.

MEASUREMENT

1. Measure the rise time of the VIDEO OUT pulse.
2. Determine the 8900A/B rise time using the following relationship:

$$t_R = \sqrt{(t_{R_{vo}})^2 - (t_{R_{pg}})^2}$$

t_R = 8900A/B rise time
$t_{R_{vo}}$ = Video Out rise time
$t_{R_{pg}}$ = Pulse Generator rise time

The rise time (t_R) must be less than 0.25 μsec.

8900B Monitor Output Bandwidth

EQUIPMENT REQUIRED

1. -hp- 212A Pulse Generator or equivalent*
2. -hp- 175A Oscilloscope or equivalent*
3. 150-ohm Load*
4. 50-ohm Load

PRELIMINARY SETUP

1. Connect the pulse generator to the oscilloscope using a 50-ohm load across the pulse generator output.
2. Adjust the pulse generator output for a 1 volt pulse as observed on the oscilloscope and measure the rise time of the pulse from the generator.
3. Disconnect the oscilloscope from the pulse generator and connect it to the 8900B MON. OUT connector using the 150-ohm load (recommended oscilloscope lead—RG-62/U — 90-ohm cable; no more than 6 feet long). Connect the pulse generator directly to the 8900B RF IN connector.

MEASUREMENT

1. Measure the rise time of the MON. OUT pulse.
2. Determine the 8900B rise time using the following relationship:

$$t_R = \sqrt{(t_{R_{mo}})^2 - (t_{R_{pg}})^2}$$

t_R = 8900B rise time
$t_{R_{mo}}$ = MON. OUT rise time
$t_{R_{pg}}$ = Pulse Generator rise time

The rise time (t_R) must be less than 0.05 μsec.

3. Calculate the 8900B MON. OUT bandwidth using the following relationship:

$$t_R = \frac{.35}{\text{bandwidth}}$$

or

$$\text{bandwidth} = \frac{.35}{t_R}$$

The bandwidth should be greater than 7 mc.

Power Level Calibration

EQUIPMENT REQUIRED

1. CW RF Generator or Generators*
2. -hp- 431B Power Meter or equivalent* (CW Power Standard)
3. -hp- 478A Thermistor Mount for -hp- 431B Power Meter
4. -hp- 130C Oscilloscope or equivalent*
5. Low VSWR Attenuators: 10 db and 3 db
6. Low Pass Filters*
7. Low VSWR, double female, Type N connector

NOTE: Depending on the type and quality of the equipment being used for this calibration, it may be necessary to use additional equipment. It also may be possible to eliminate some of the items listed.

EXAMPLES:

1. Insufficient output power from the generator might require the use of a stub tuner to obtain a better impedance match and increased power.
2. Increased power in the 10 to 500 mc range can be obtained by using a BRC Type 230A Signal Generator Power Amplifier.
3. The low pass filters may not be necessary if the signal generators used have second harmonic power component suppression greater than 27 db (or 54 db in terms of voltage).

PRELIMINARY SETUP

1. Connect the equipment as shown in Fig. 15.
2. Set the 8900A/B Function Switch to the MEAS position.
3. Adjust the RF Generator frequency to 50 mc.
4. Adjust the RF Generator output until the CW Power Standard reads 12 dbm.

Path Attenuation Check

1. Remove the equipment connectors from the 8900A/B RF IN and BOL. OUT connectors and insert the double female, "N" connector

**See Recommended Equipment List under Adjustment and Calibration*

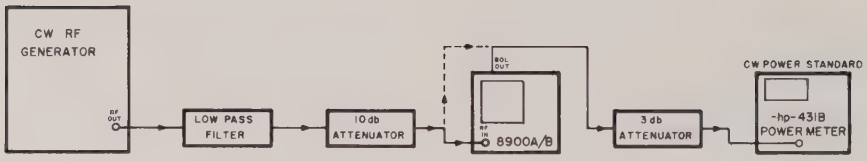


Figure 15. Path Attenuation Check Set-up

in place of the 8900A/B, without touching any of the controls on the generator. The CW Power Standard reading will increase by approximately 16 db to nominally 4 dbm. Note and record the exact change in power, which is the path attenuation of the 8900A/B at 50 mc.

2. Reconnect the equipment as shown in Fig. 15.

3. Retune the RF Generator for the next desired frequency and repeat steps 1 through 4 of the Preliminary Setup and step 1 of the Path Attenuation Check for each frequency being calibrated.

NOTE: Custom Calibration Charts are calibrated at 50 mc, 100 mc, and 100 mc increments up to and including 2000 mc. The meter is calibrated at 900 mc so the path attenuation at this frequency must be checked.

Meter Calibration

1. Connect the equipment as shown in Fig. 16.

2. Adjust the RF Generator to 900 mc and, without changing the frequency, turn the RF output off.

3. Rotate the 8900A/B Function Switch to the CAL position.

4. Set the oscilloscope vertical amplifier to direct coupling with the sweep set to "free run".

5. Adjust the 8900A/B NULL control until the two horizontal lines on the oscilloscope coincide. Use the highest oscilloscope vertical sensitivity practical for the most precise adjustment.

6. Rotate the 8900A/B Function Switch to the MEAS position.

7. Turn on the RF Generator and adjust the output level until the CW Power Standard reads 100 mw, minus the path attenuation determined for 900 mc. The input at the 8900A/B RF IN connector is 100 mw.

EXAMPLE: If the path attenuation for the particular instrument checked measured 16.2 db at 900 mc for 100 mw at the 8900A/B RF IN connector, the CW Power Standard should indicate 20 dbm -16.2 db or +3.8 dbm. Adjust the output of the RF Generator for a reading of +3.8 dbm, as indicated on the CW Power Standard. This will make the power at the 8900A/B RF IN connector exactly 100 mw.

8. Adjust the COARSE and FINE controls on the 8900A/B for 100 mw (0 db) reading on the RF Peak Power Meter.

9. At this point, the two horizontal lines should exactly coincide. If not, adjust R20.

NOTE: If balance cannot be attained, adjust R20 for minimum separation of the horizontal lines. Then, adjust the COARSE and FINE panel controls until the horizontal lines coincide. Adjust R18 until the panel meter reads exactly 100 mw (0 db).

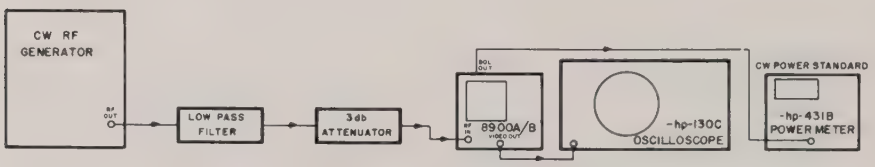


Figure 16. Meter Calibration Check Set-up

10. Verify the NULL adjustment by repeating steps 2 through 5 of this procedure.

11. Rotate the 8900A/B Function Switch to the MEAS position.

12. Turn the RF Generator on and reduce the power output, as indicated on the CW Power Standard, by exactly 10 db.

13. Adjust the COARSE and FINE controls on the 8900A/B until the two horizontal lines on the oscilloscope exactly coincide. The RF Peak Power Meter should read −10 db.

NOTE: If the meter does not read −10 db, note the error and readjust the COARSE and FINE controls until the meter reads exactly 0 db. Then, readjust R18 until the meter indicates the same error (and in the same direction above or below 0 db) as it did at −10 db.

14. Increase the RF Generator output by exactly 10 db, as read on the CW Power Standard.

15. Repeat steps 8 through 13 until 0 db and −10 db read correctly.

16. Verify the NULL adjustment by repeating steps 2 through 5 of this procedure. If the NULL control is adjusted, repeat steps 6 through 15.

17. Rotate the 8900A/B Function Switch to the CAL position. Adjust the ac line voltage to 115 vac. Adjust R12 until the pointer falls within the calibration marking on the meter.

18. Tighten the locking nuts on the internal adjustable controls: R12, R18, and R20.

Frequency Sensitivity

1. Connect the equipment as shown in Fig. 16.

2. With the RF Generator adjusted to a frequency of 50 mc, turn the RF output off.

3. Rotate the 8900A/B Function Switch to the CAL position and adjust the NULL control until the two horizontal lines on the oscilloscope coincide.

4. Rotate the 8900A/B Function Switch to the MEAS position.

5. Turn the RF Generator on and adjust the power level for 100 mw (0 db) at the 8900A/B RF IN connector. The CW Power Standard will read 100 mw minus the path attenuation determined for each frequency. (See Path Attenuation Check.)

6. Adjust the COARSE and FINE controls until the two horizontal lines on the oscilloscope coincide. Note and record the RF Peak Power Meter reading. The deviation from 0 db in the meter reading is used to prepare the Custom Calibration Chart.

NOTE: Negative readings from this procedure are plotted as positive corrections on the Custom Calibration Chart and vice versa.

EXAMPLE: At 600 mc, if the meter reads −0.8 db, the Custom Calibration Chart will show +0.8 db correction. The RF Peak Power Meter is adjusted for 0 db at 900 mc, so this frequency becomes the 0 db reference for the Custom Calibration Chart.

SECTION VII
REPLACEMENT PARTS

GENERAL

Tables of replaceable electrical and mechanical parts for the 8900A/B are included in this section. Unless otherwise specified, the parts listed are used in both the 8900A and 8900B. Locations of these parts are given in Fig. 17 through 23, inclusive. When ordering replacement parts, specify the BRC part number and the description given in the replacement parts tables. See Section VI — MAINTENANCE for detailed disassembly and assembly procedures and for the adjustment and/or calibration procedures required after component replacement.

For convenience in obtaining replacement parts locally, a List of Manufacturers is given below. This list is keyed into the tables of replaceable parts where the manufacturer's type numbers are also given. When a manufacturer's code and type number are not given, the part is a special part manufactured by or for BRC.

LIST OF MANUFACTURERS

Code	Manufacturer's Name
AB	Allen-Bradley Company
AER	Aerovox Corporation
APC	Alden Products Company
BMD	Bussmann Mfg. Div., McGraw-Edison
CEC	Corning Electronic Components, Corning Glass Works
CMC	Clarostat Mfg. Co., Inc.
GA	Good-All Electric Mfg. Company
JEC	James Electronics, Inc.
LI	Lectrohm, Inc.
MIL	MilSpec
MMC	Methode Mfg. Corporation
TMC	Tower Mfg. Corporation
WMC	Weinschel Engineering Co., Inc.

TABLE OF REPLACEABLE ELECTRICAL PARTS

CIRCUIT SYMBOL	VALUE	DESCRIPTION	BRC PART NO.	MFG.	MFG'S TYPE NO.
AT1		Attenuator	0950-0083	WMC	50-10
AT2		Termination: 50 ohms, Type N male connector	0950-0082		
C1, 2	40 μf	Capacitor: Fixed, 150V	0180-0223	AER	PRS-1470
C3		Special (Part of Z2)			
C4	.047 μf	Capacitor: Fixed, ±10%, 100V (8900B only)	0160-0741	GA	663UW
C5, 6	10 μf	Capacitor: Fixed, 25V (8900B only)	0180-0258	AER	PTT-79

CIRCUIT SYMBOL	VALUE	DESCRIPTION	BRC PART NO.	MFG.	MFG'S TYPE NO.
CR1-4		Rectifier, Diode: 400V, 0.5A, Silicon, 1N1763	1901-0126		
		Rectifier, Diode: 400V, 0.5A, Silicon	1901-0028		
CR5		Detector, Diode (Part of Z2)	1900-0013	MA	MA425
CR6		Diode, Zener: 8.9-9.7V at 10 MA, 750MW TEMP. COMP., 1N2620	1902-1057		
CR7		Diode, Zener: 12V ±10%, 400MW, 1N759	1902-0158		
DS1		Lamp, Indicator: Red, NE2H	1450-0048		
F1		Fuse: .3A, 115V, SLO-BLO	2110-0044	BMD	MDL
		.15A, 230V, SLO-BLO	2110-0058	BMD	MDL
G1		Chopper: 6.3V, 50-60 cps	0490-0122	JEC	C-1800
J1		Part of W2			
J2-4		Part of Z1			
J5		Part of AT1			
J6		Connector: BNC, UG-262/U	1250-0192		
J8		Binding Post: Red (8900B only)	1510-0007		
J9		Same as J6 (8900B only)			
J10		Binding Post: Black (8900B only)	1510-0006		
J11		Receptacle: Printed circuit board (8900B only)	0135-0194	MMC	SD615S
M1		Meter (8900A)	1120-0164		
		Meter (8900B)	1120-0167		
P2		Part of W2			
P3		Part of Z2			
P4		Part of AT1			
P5		Part of AT2			
P7		Connector, Receptacle: 3-prong male	1251-0148	TMC	H1061-1G
Q1, 2		Transistor: 2N706, NPN (8900B only)	1854-0034		
R1, 2	820Ω	Resistor: Fixed, ±5%, 2W	0692-8215	AB	HB
R3	47KΩ	Resistor: Fixed, ±5%, 2W	0686-4735	AB	HB
R4	6.8KΩ	Resistor: Fixed, ±5%, ½W	0686-6825	AB	EB
R5	470Ω	Resistor: Fixed, ±5%, ½W	0686-4715	AB	EB
R6	60Ω	Resistor: Fixed, ±1%, ¼W (Part of Z2)	0724-0059		
R7, 8	6KΩ	Resistor: Fixed, ±5%, 5W	0812-0059	LI	C5
R9	1KΩ	Resistor: Fixed, ±5%, 1W	0689-1025	AB	GB
R10	50Ω	Resistor: Variable, ±10%, 2W	2100-0764	CMC	43-40
R11	3010Ω	Resistor: Fixed, ±1%, ½W	0727-0937	MIL	RN20X
R12	1.5KΩ	Resistor: Variable, ±5%, 2W	2100-0768	CMC	43C2-1500
R13	680Ω	Resistor: Fixed, ±5%, ½W	0686-6815	AB	EB
R14	1500Ω	Resistor: Fixed, ±5%, ½W	0686-1525	AB	EB
R15, 16	500Ω	Resistor: Variable, ±10%, 2W, Dual	2100-0767	CTS	2W2G
R17	30Ω	Resistor: Variable, ±10%, 3W	2100-0763	CMC	58-30
R18	400Ω	Resistor: Variable, ±5%, 2W	2100-0766	CMC	43C2-400
R19	1470Ω	Resistor: Fixed, ±1%, ½W (8900A)	0727-0881	MIL	RN20X
	1540Ω	Resistor: Fixed, ±1%, ½W (8900B)	0727-0974	MIL	RN20X
R20	50Ω	Resistor: Variable, ±5%, 2W	2100-0765	CMC	43C2-50

CIRCUIT SYMBOL	VALUE	DESCRIPTION	BRC PART NO.	MFG.	MFG'S TYPE NO.
R21-23	40.91Ω	Part of Z1	0727-0956		
R24	470Ω	Same as R5			
R25	220Ω	Resistor: Fixed, ±5%, ½W	0686-2215	AB	EB
R26	33KΩ	Resistor: Fixed, ±5%, ½W	0686-3335	AB	EB
R27	18KΩ	Resistor: Fixed, ±5%, ½W (8900B only)	0686-1835	AB	EB
R28	10KΩ	Resistor: Fixed, ±5%, ½W (8900B only)	0686-1035	AB	EB
R29	4.7KΩ	Resistor: Fixed, ±5%, ½W (8900B only)	0686-4725	AB	EB
R30	1KΩ	Resistor: Fixed, ±5%, ½W (8900B only)	0686-1025	AB	EB
R31	10KΩ	Resistor: Fixed, ±5%, ½W (8900B only)	0758-0006	CEC	C-20
S1		Switch, Wafer: OFF-MON./ CAL-MEAS	3100-0762		
S2		Switch, Snap Slide	3101-0033		
T1		Transformer, Power	9100-0271		
TP1-4		Jack, Test: Red (8900A only)	1251-0397	APC	110BC1
W1		Power Cord	8120-0078		
W2		Cable Assembly (includes J1 & P2)	08900-60003		
Z1		Power Divider Assembly	08900-60007		
Z2		Detector Assembly	08900-60006		
Z3		Printed Circuit Board Assembly	08900-60204		

TABLE OF REPLACEABLE MECHANICAL PARTS

BRC PART NO.	DESCRIPTION	QTY. PER UNIT
0340-0086	Insulator, Binding Post (8900B only)	1
0340-0090	Insulator, Binding Post (with locating key) — 8900B only	1
0340-0096	Terminal, Insulated (8900B only)	1
0370-0047	Knob	3
0370-0077	Knob	1
0510-0123	Clip, Pilot Light Retaining	1
0590-0052	Nut, Tinnerman	4
1200-0020	Socket, Chopper (G1)	1
1400-0084	Fuseholder	1
1400-0099	Ty-Rap, Cable	7
1400-0161	Ty-Rap: Electrolytic Mounting (8900A only)	2
1400-0162	Clamp, Chopper	1
1490-0032	Stand, Tilt	1
5040-0700	Hinge, Tilt Stand	2
5060-0728	Foot Assembly	2
08900-00203	Printed Circuit Board (less components)	1
08900-20001	Insulator, Detector	1
08900-60011	Terminal Board Assembly (8900A only)	2

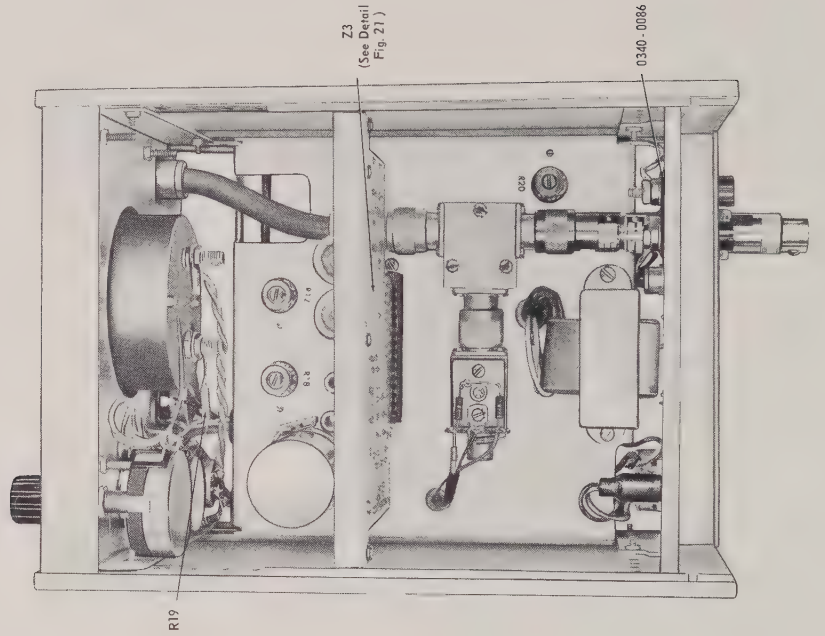
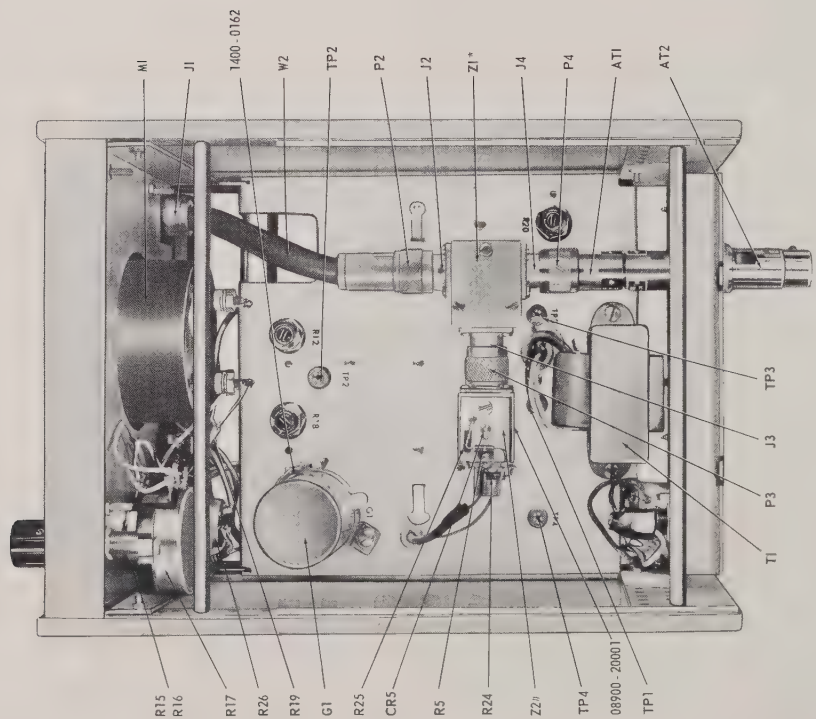


Figure 18. 8900B — Top View



* Contains R21, 22, 23

// Contains CR5, C3, R6

Figure 17. 8900A — Top View

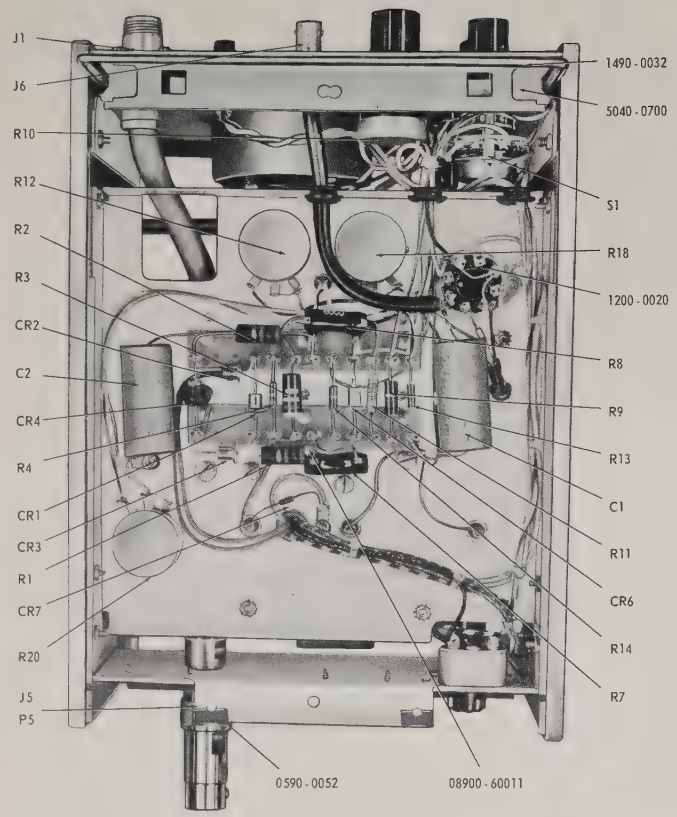


Figure 19. 8900A — Bottom View

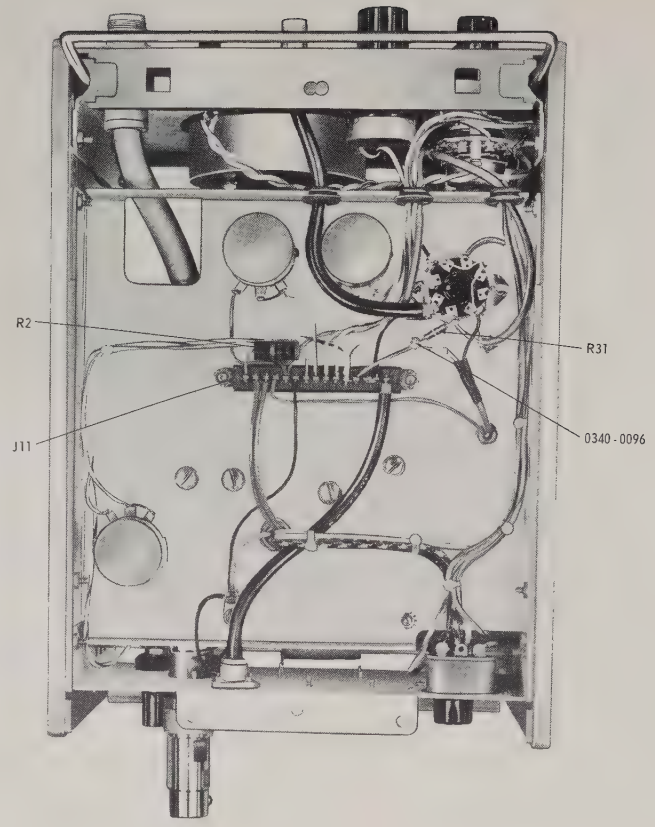


Figure 20. 8900B — Bottom View

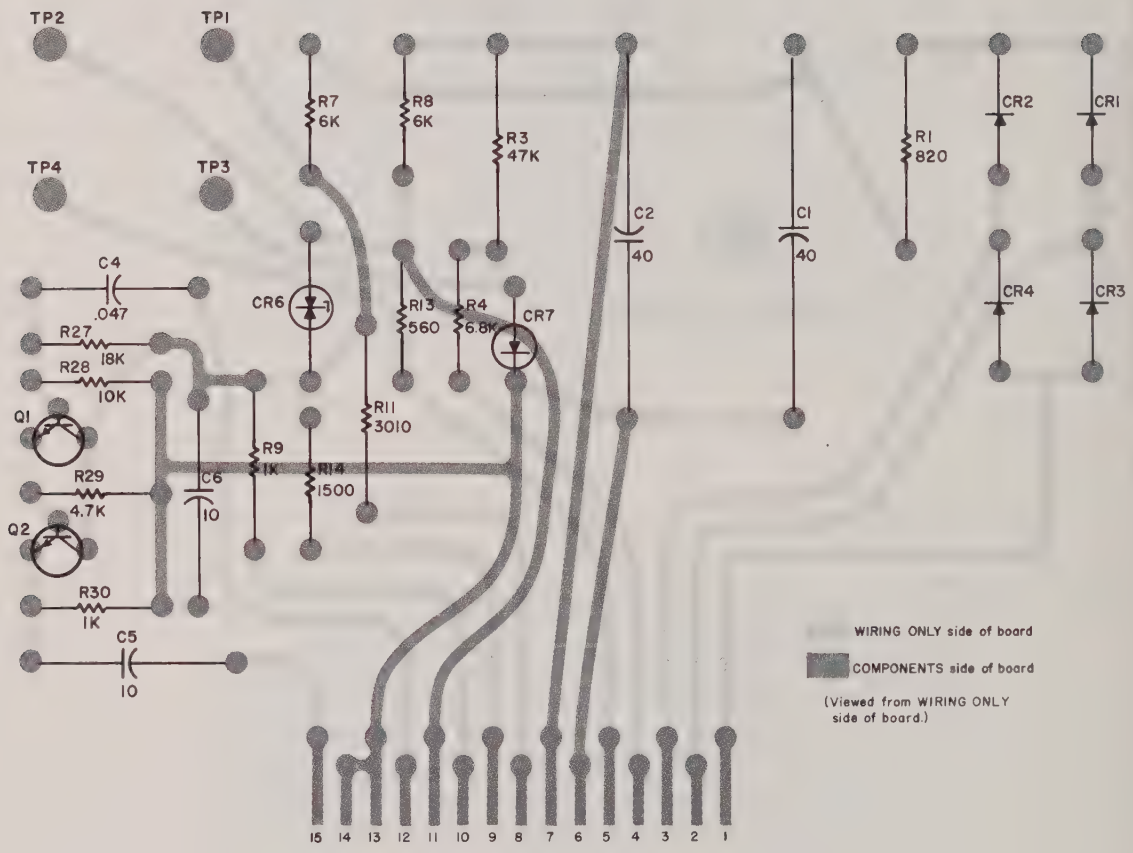


Figure 21. 8900B — Printed Circuit Board

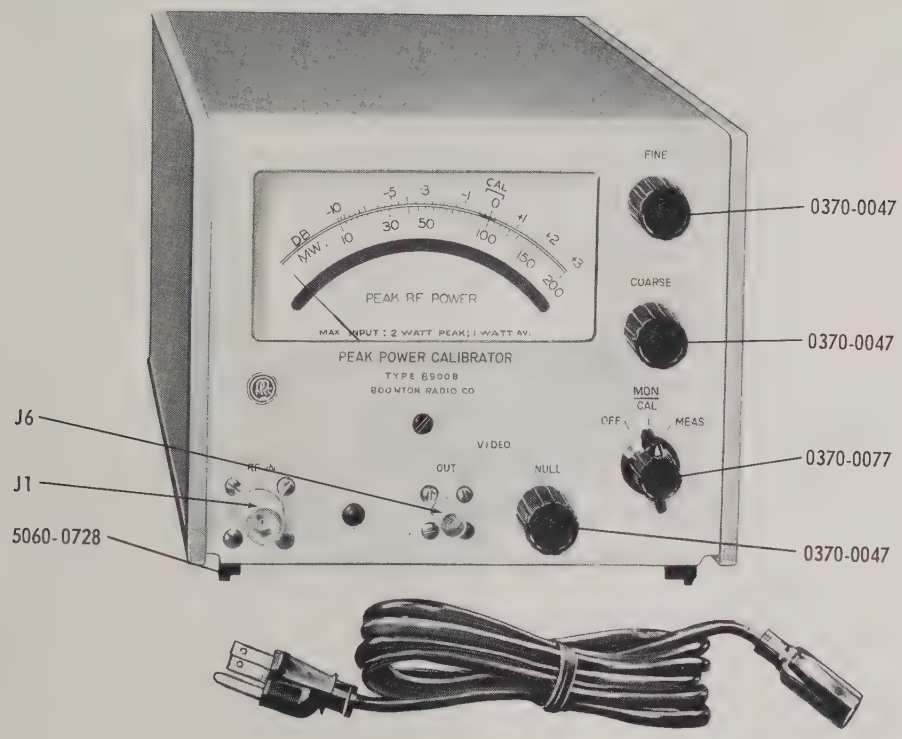


Figure 22. 8900A/B Front Panel Mechanical Parts

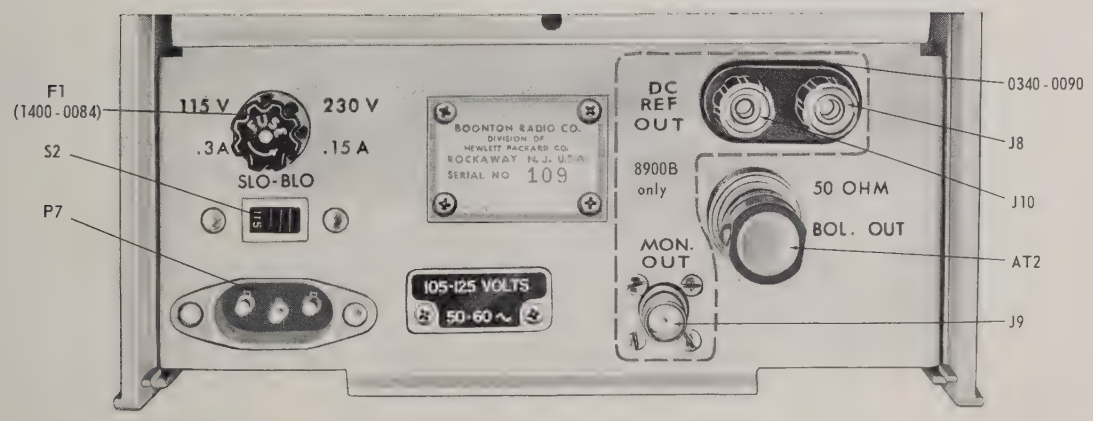
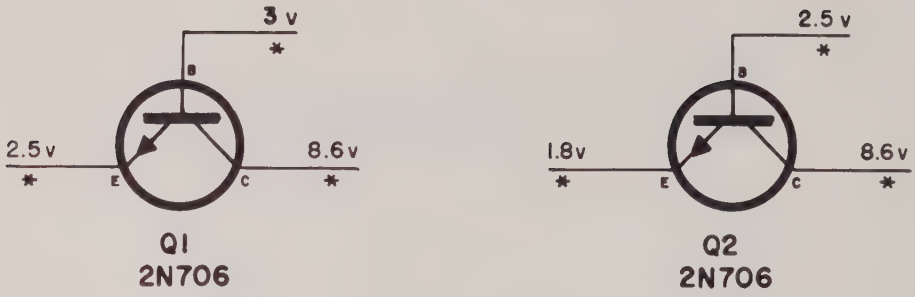
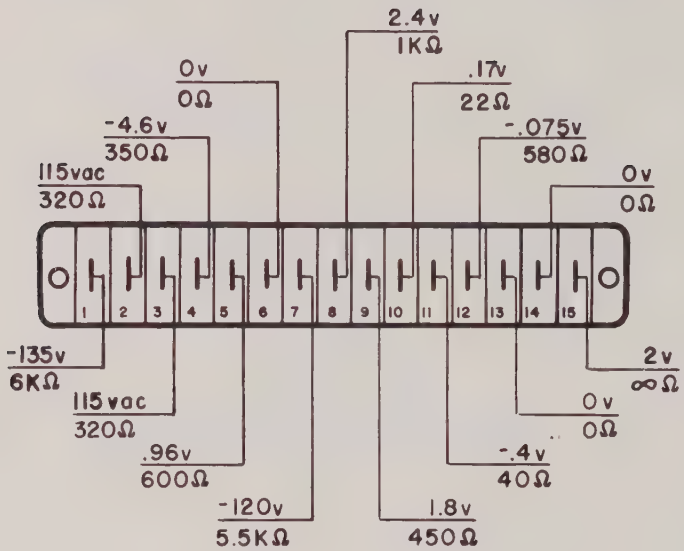
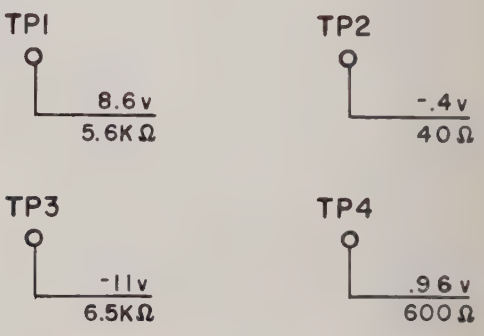


Figure 23. 8900A/B Rear Panel Mechanical Parts





J11
RECEPTACLE
(Bottom View)



TEST POINTS

Function switch - MEAS
Meter reading - 0db(100mw)
* Not significant

VOLTAGE AND RESISTANCE CHART

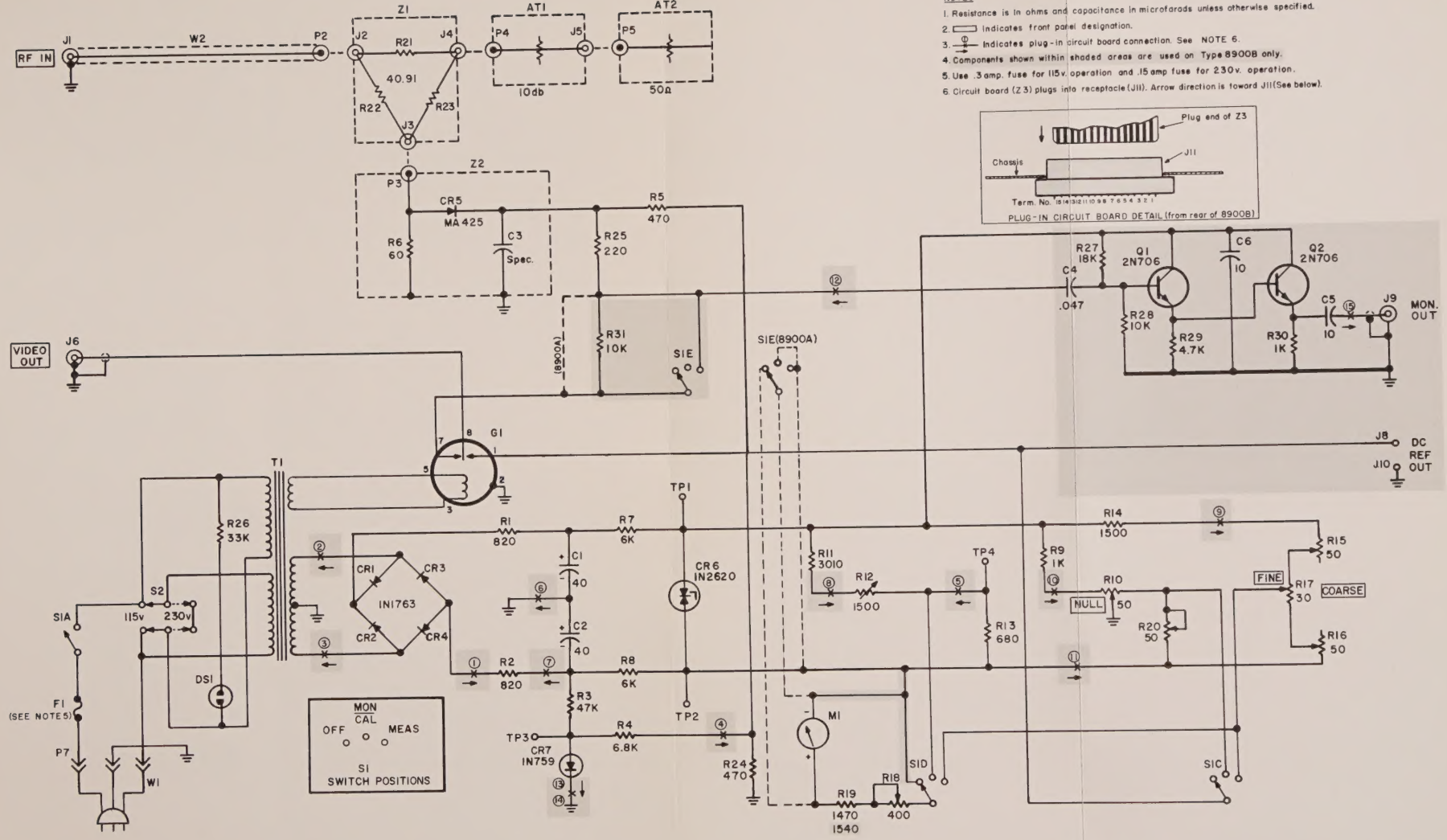


Figure 24. 8900A/B Schematic Diagram

MP MASTER
MA25132